

Name of the Course	: CBCS B.Sc. (Mathematical Sciences) / B.Sc. (Physical Sciences)/ B.Sc. (Life Sciences)/Applied Sciences
Unique Paper Code	: 42357501
Name of the Paper	: DSC-Differential Equations
Semester	: V
Duration	: 3 Hours
Maximum Marks	: 75

Attempt any **four** questions. All questions carry equal marks.

1. Find an integrating factor and solve the differential equation

$$(y^2x + y^2 + y)dx + (2xy + 1)dy = 0$$

Solve the differential equation

$$3x(1 - x^2)y^2 \frac{dy}{dx} + (2x^2 - 1)y^3 = x^3$$

Also, solve the differential equation

$$(3y - 7x + 7)dx + (7y - 3x + 3)dy = 0$$

2. Solve the differential equation

$$\frac{d^2y}{dx^2} - y = x^2 \cos x$$

Also, solve the following initial value problem

$$x^2 \frac{d^2y}{dx^2} - 2y = 4x - 8, \quad y(1) = 4, y'(1) = -1$$

3. Given that  $y = e^{2x}$  is a solution of

$$(2x + 1) \frac{d^2y}{dx^2} - 4(x + 1) \frac{dy}{dx} + 4y = 0,$$

Find the linearly independent solution by reducing the order and also write the general solution.

Use the method of variation of parameters to solve the equation

$$\frac{d^2y}{dx^2} + 6 \frac{dy}{dx} + 9y = \frac{e^{-3x}}{x^3}$$

4. Find a family of oblique trajectories that intersect the family of parabolas  $y^2 = cx$  at angle  $60^\circ$ .

Also, solve the system of linear differential equations

$$2 \frac{dx}{dt} + 4 \frac{dy}{dt} + x - y = 3e^t$$

$$\frac{dx}{dt} + \frac{dy}{dt} + 2x + 2y = e^t$$

5. Find the general solution of the equation

$$(y - xu) \frac{\partial u}{\partial x} + (x + yu) \frac{\partial u}{\partial y} = x^2 - y^2$$

Apply the method of separation of variables to solve the equation:

$$\frac{\partial u}{\partial x} - \frac{\partial u}{\partial y} + u = 0, \quad \text{with } u(x, 0) = 4e^{-3x}$$

6. Find the partial differential equation arising from the surfaces

$$z = f(x^2 + y^2)$$

Also, reduce the equation

$$\frac{\partial^2 u}{\partial x^2} + 2x \frac{\partial^2 u}{\partial x \partial y} + x^2 \frac{\partial^2 u}{\partial y^2} = 0$$

to canonical form.